



Results & Status of the Emirates Mars Mission (Hope Probe)

Hessa Almatroushi



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EMM Science

A

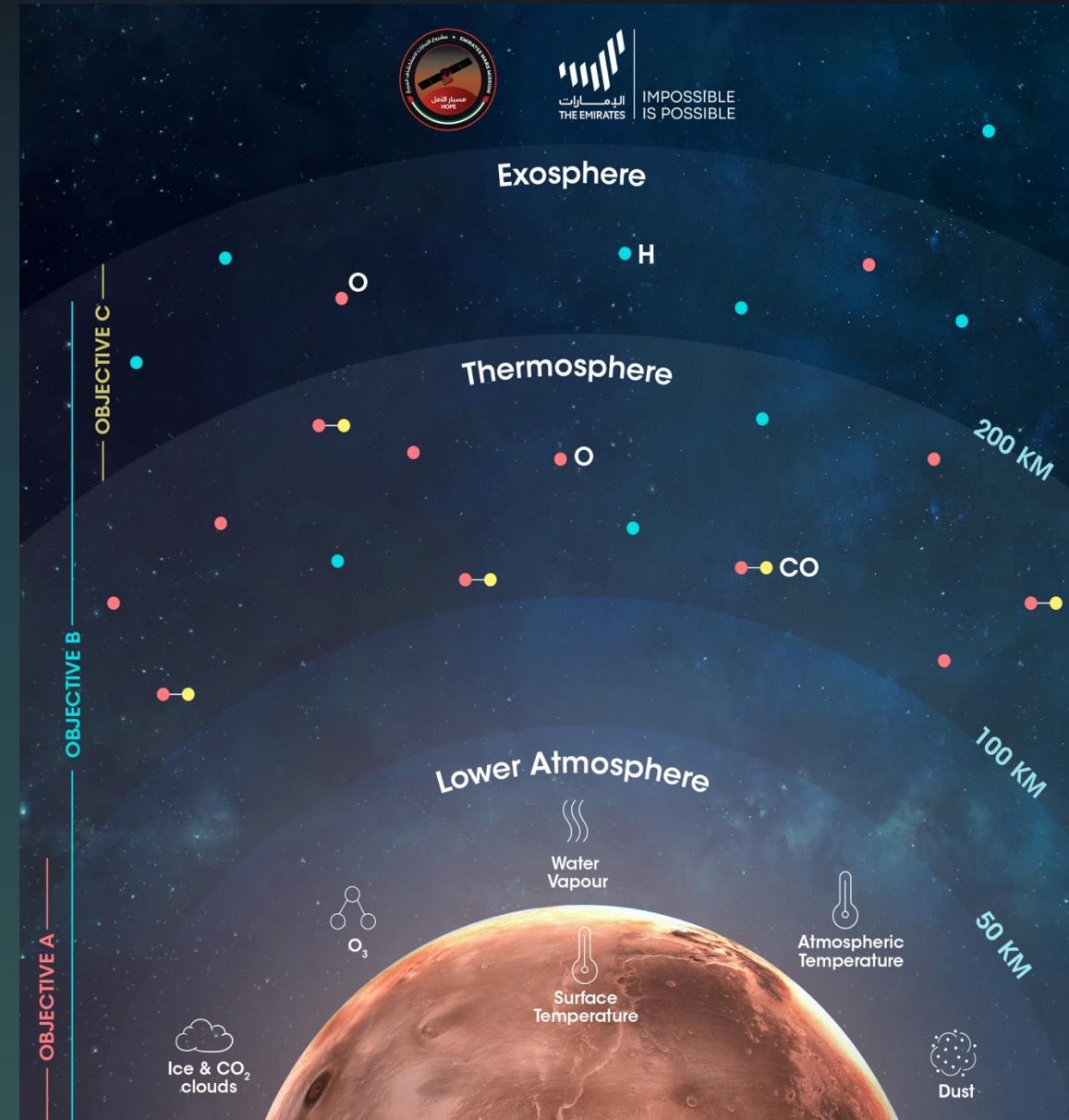
Characterize the state of the Martian lower atmosphere on global scales and its geographic, diurnal and seasonal variability

B

Correlate rates of thermal and photochemical atmospheric escape with conditions in the collisional Martian atmosphere

C

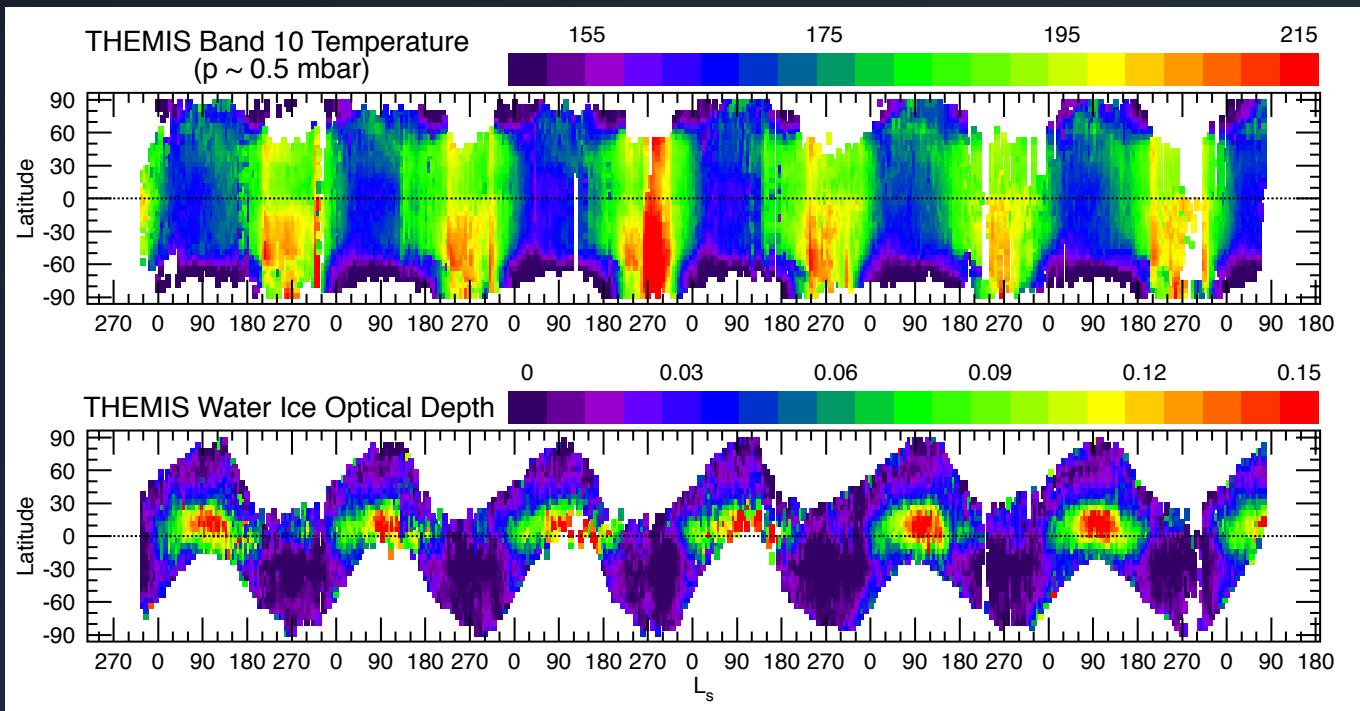
Characterize the spatial structure and variability of key constituents in the Martian exosphere



EMM Uniqueness

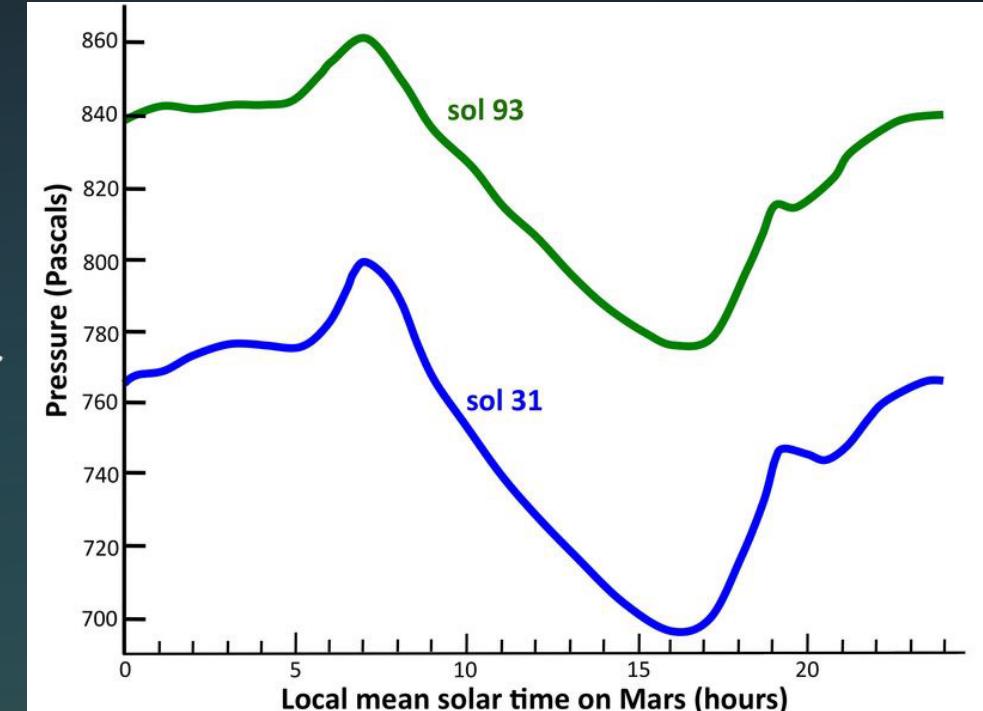
Previous Measurement Coverage

Mars Odyssey
(THEMIS Instrument)



*Orbiting spacecraft measure the atmosphere
globally at one time of day*

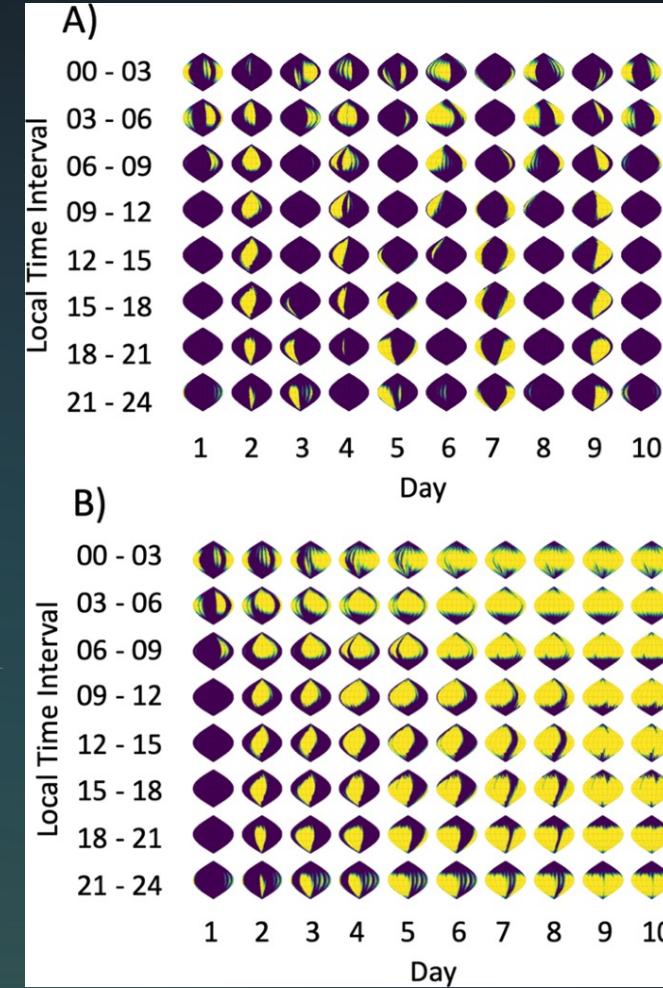
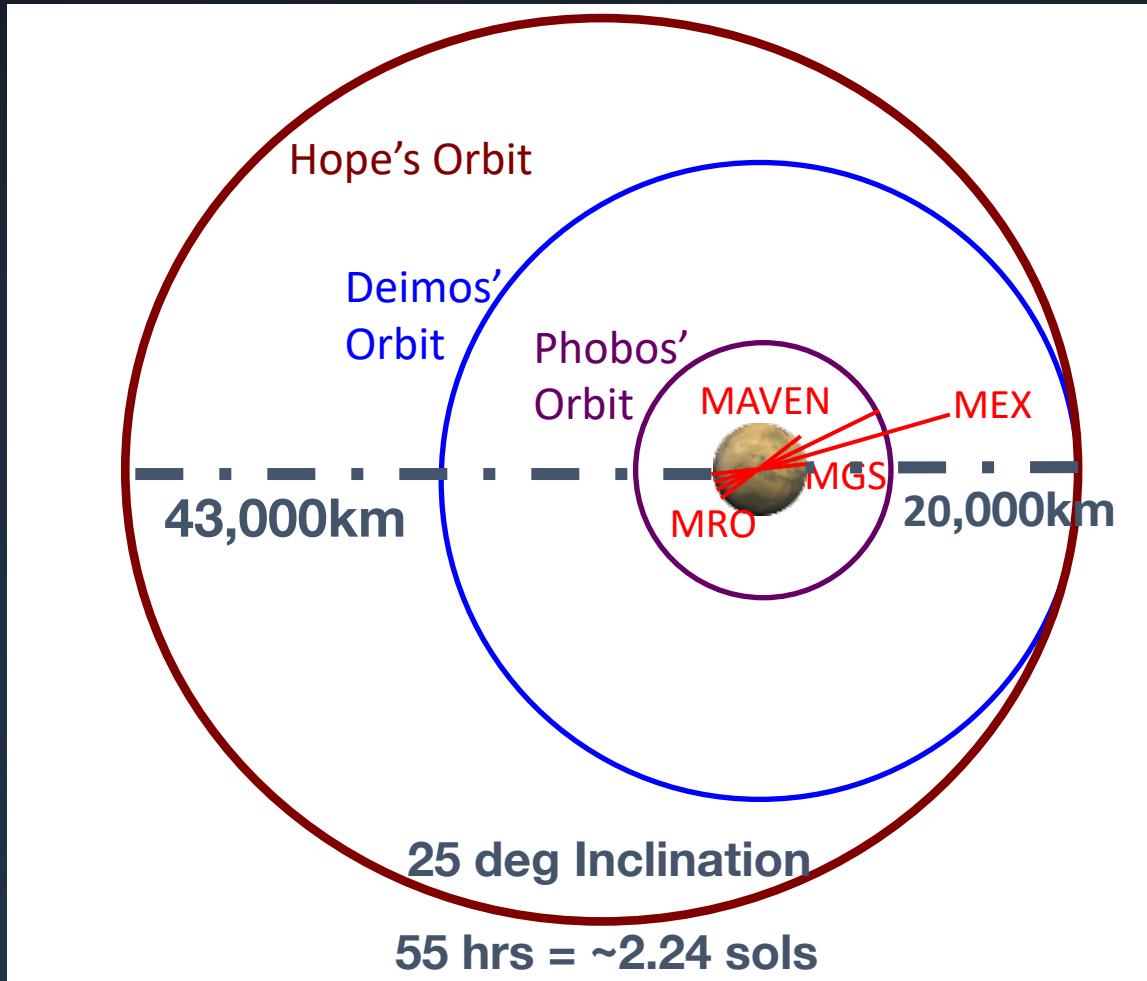
Curiosity Rover
(REMS Instrument)



*Landed spacecraft measure the
atmosphere locally at many times of
day*

EMM Uniqueness

Hope Probe Coverage



*Only EMM will have the combination of global geographic & local time coverage
on diurnal and sub-seasonal timescales to allow detailed assessment of atmospheric circulation and transport*

EMM Instruments & Science

EMIRATES MARS INFRARED SPECTROMETER (EMIRS)



Spatial Resolution: ~100-300 km
Spectral Bands: 6.0-100+ μm

Dust optical depth

Temperature Profile (0-50km)

Ice optical depth

Surface Temperature

Water vapor column abundance

EMIRATES EXPLORATION IMAGER (EXI)



Spatial Resolution: ~10 km
Spectral Bands: 220, 260, 320, 437, 546, 635 nm

Ice optical depth

Ozone column abundance

Color Image of Mars

EMIRATES MARS ULTRAVIOLET SPECTROMETER (EMUS)



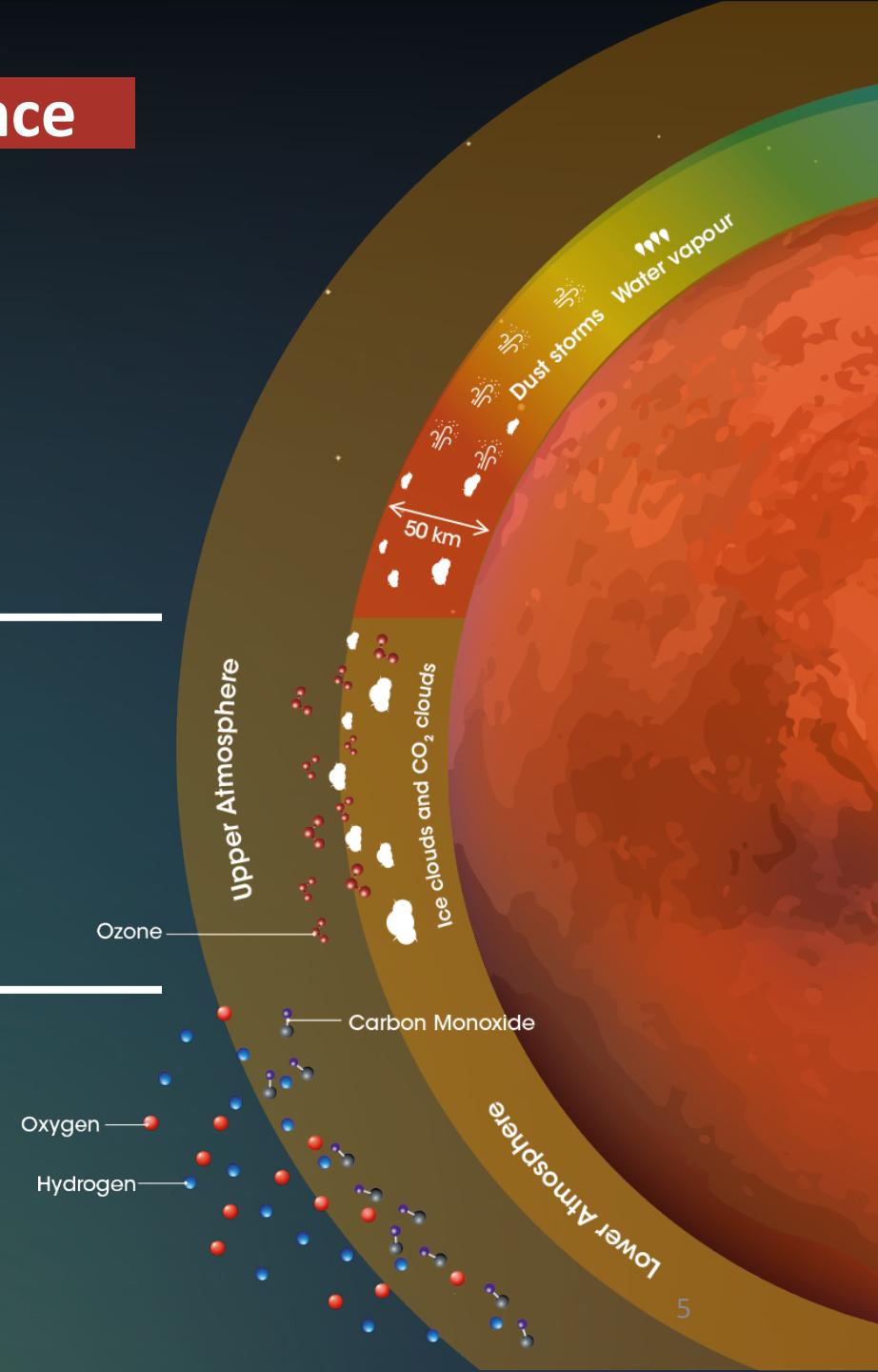
Spatial Resolution: < 300km
Spectral Bands: 100-170 nm

Density of Oxygen Corona

Relative Column Density of O

Density of Hydrogen Corona

Relative Column Density of CO



A

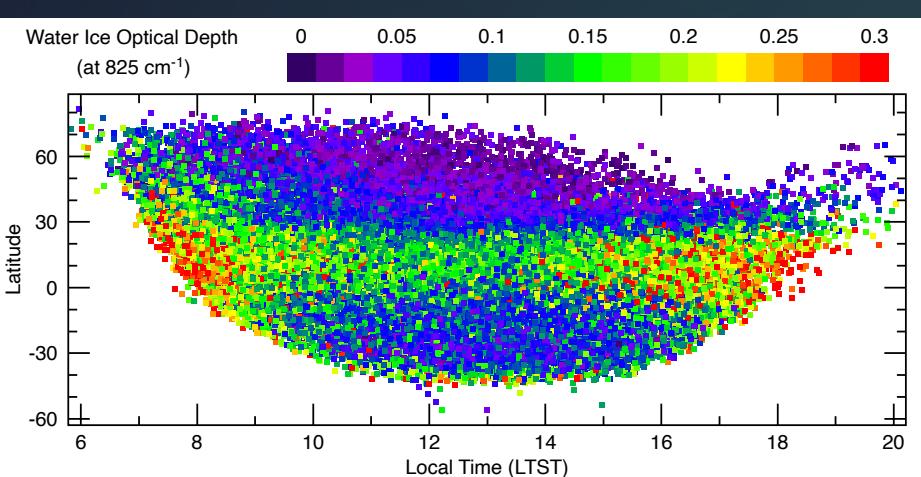
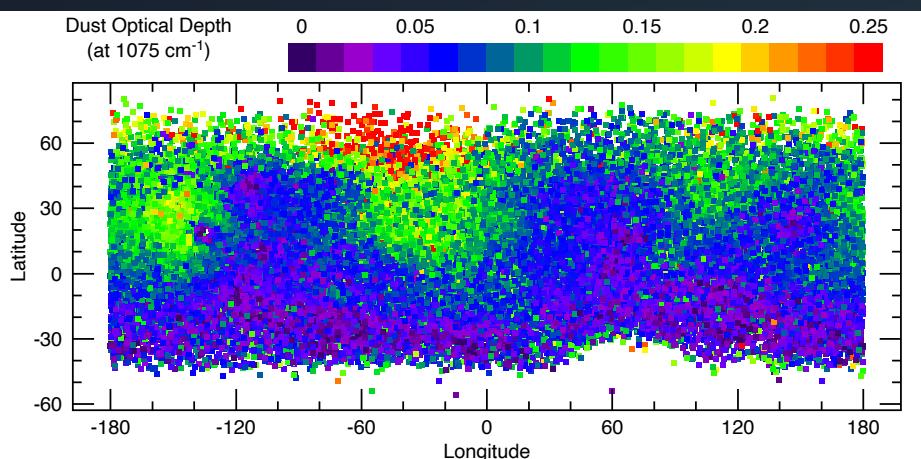
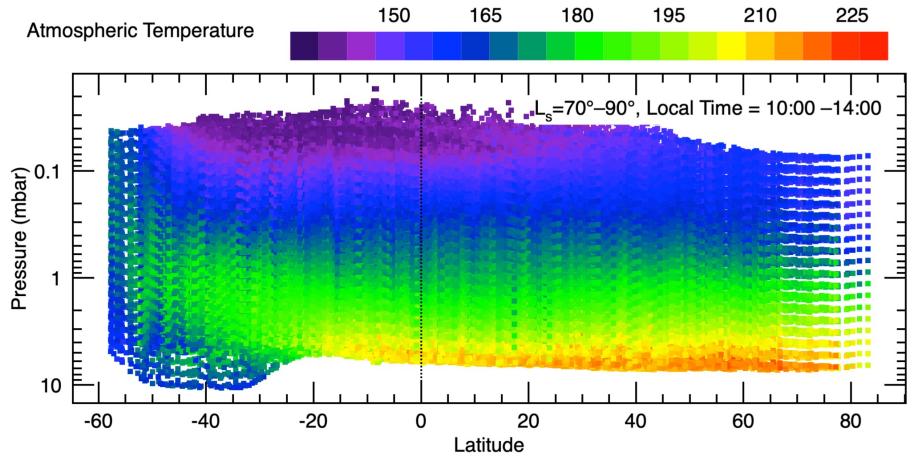
Characterize the state of the Martian lower atmosphere on global scales and its geographic, diurnal and seasonal variability



EMIRS



EXI

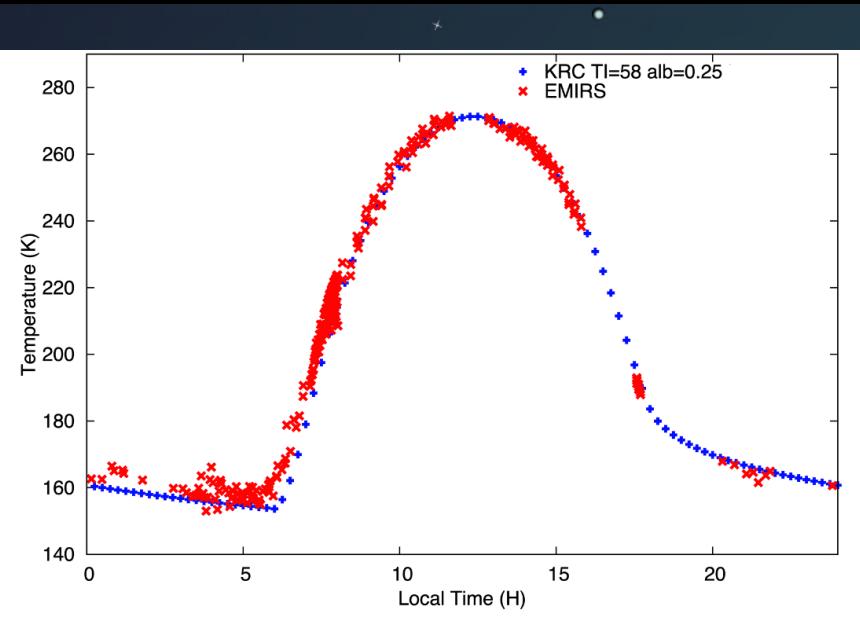
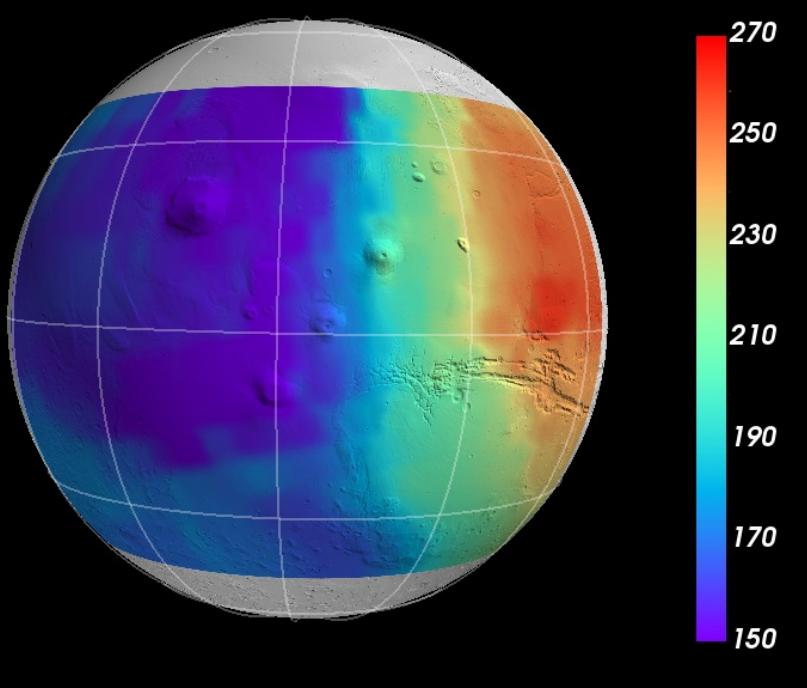


EMIRS Science

EMIRS thermal-infrared spectra enable the retrieval of:

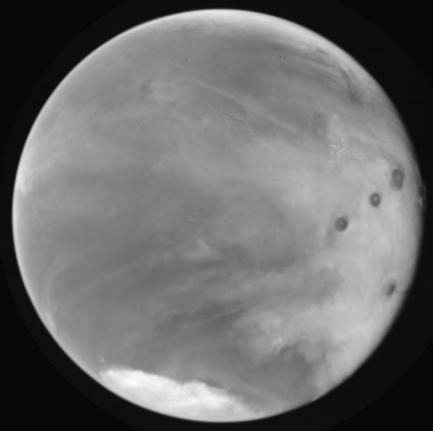
- **Atmospheric temperature** profiles from 0 – 50 km (top panel)
- Mapping of **water vapor and aerosols**, such as dust (middle panel)
- Characterization of the **diurnal variations** of all quantities such as clouds (bottom panel)
- **Surface temperature**, thermophysical properties, and more! (next slide)

EMIRS SCIENCE



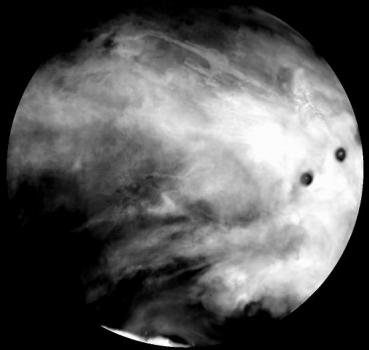
- EMIRS captures the diurnal surface temperature variation on Mars
- Data from multiple seasons, local times, wavelengths, and viewing geometries will provide a unique opportunity to derive parameters such as:
 1. Full-diurnal apparent thermal inertias
 2. Seasonal/diurnal layering
 3. Surface roughness at cm scales
 4. Rock abundance and fine-component thermal inertia
 5. Formation timing of diurnal frosts

Radiance (I/F)



2021-06-16 LS=59.7°

Water Ice Optical Depth

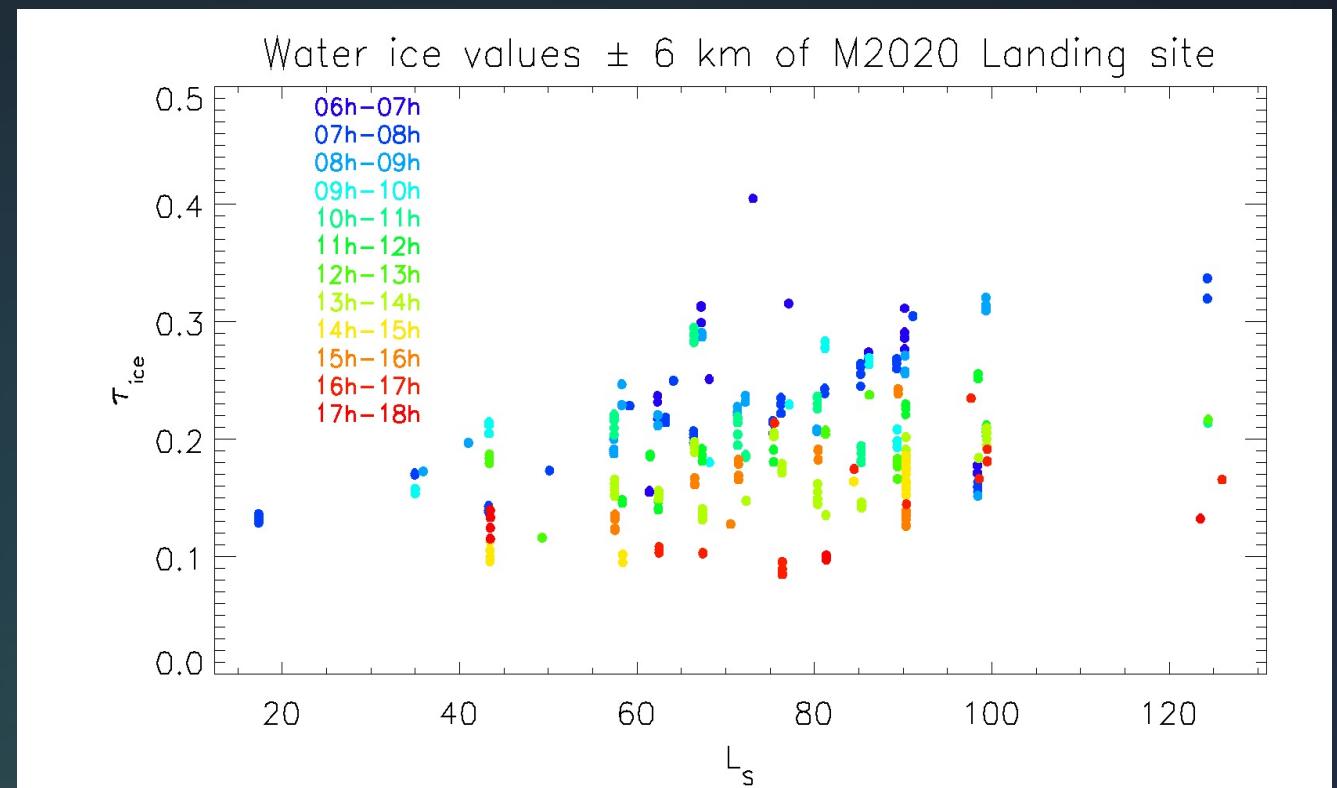


Optical Depth range:

~0 (black) to 0.5 (saturated white),
 $e < 65^\circ$

EXI SCIENCE

- EXI bands are used to retrieve water ice clouds (slide images) and ozone.



Cloud retrieval algorithm is still being “tuned”

B

Correlate rates of thermal and photochemical
atmospheric escape with conditions in the
collisional Martian atmosphere



EMIRS

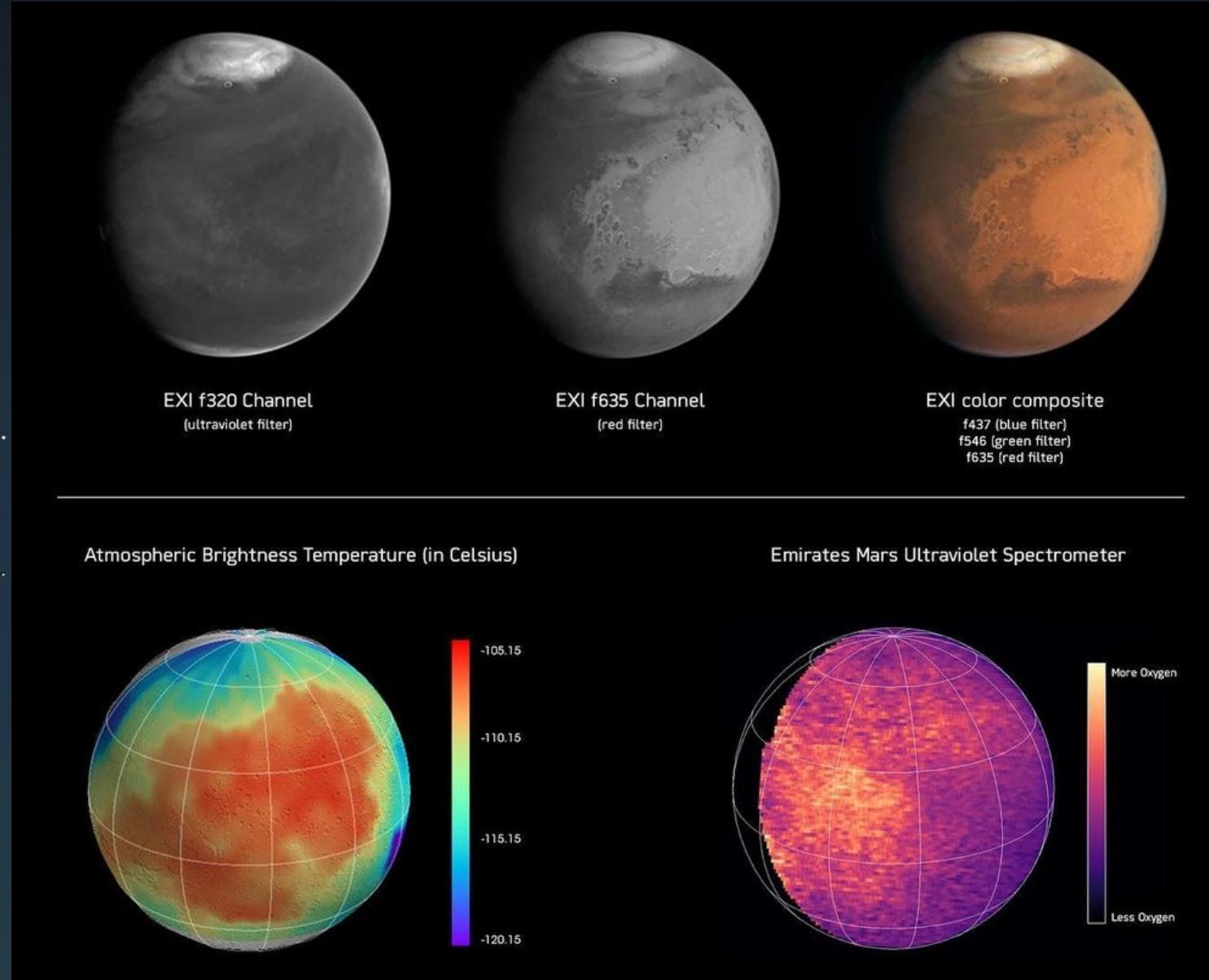


EXI



EMUS

EMM INSTRUMENTS SYNERGY

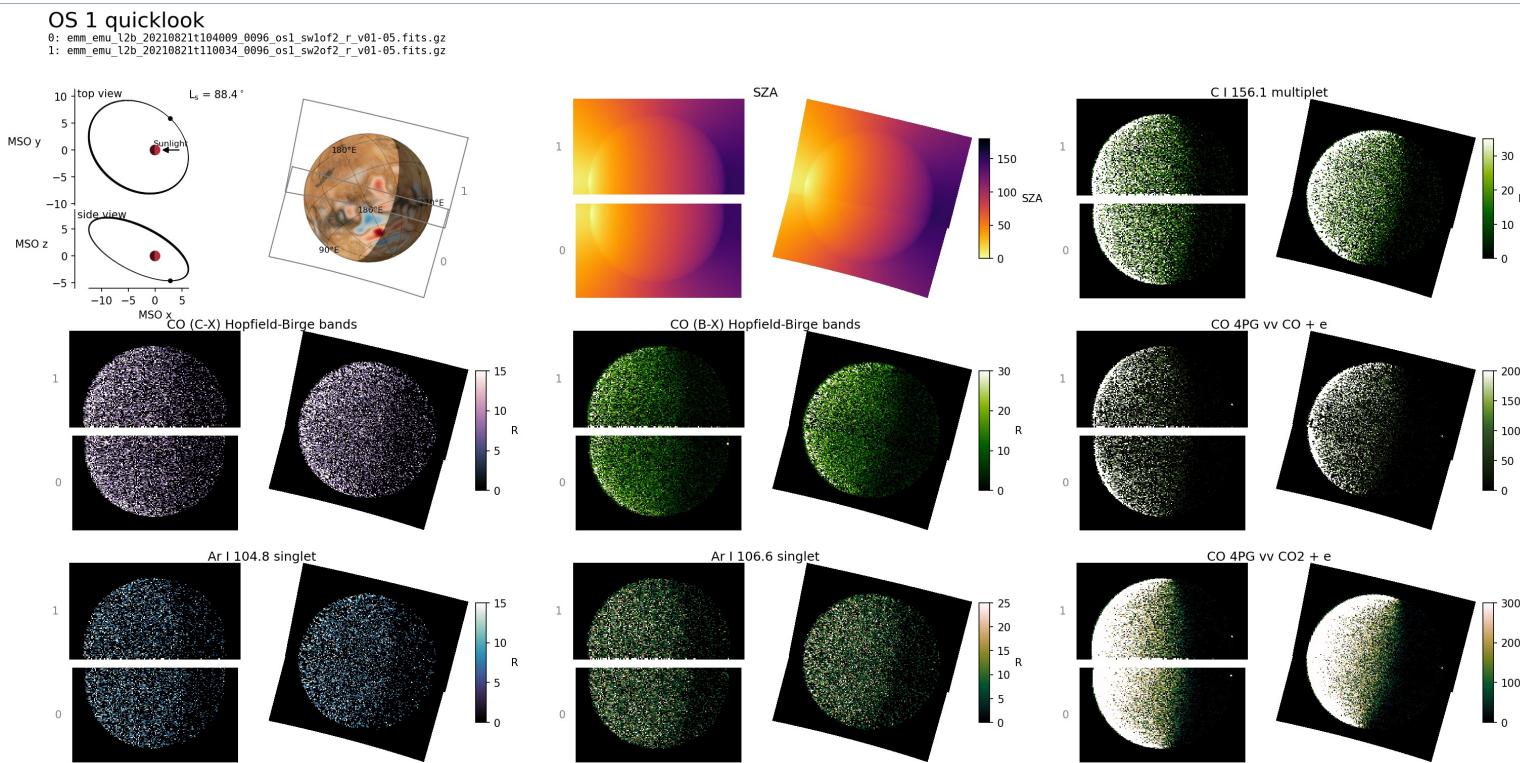
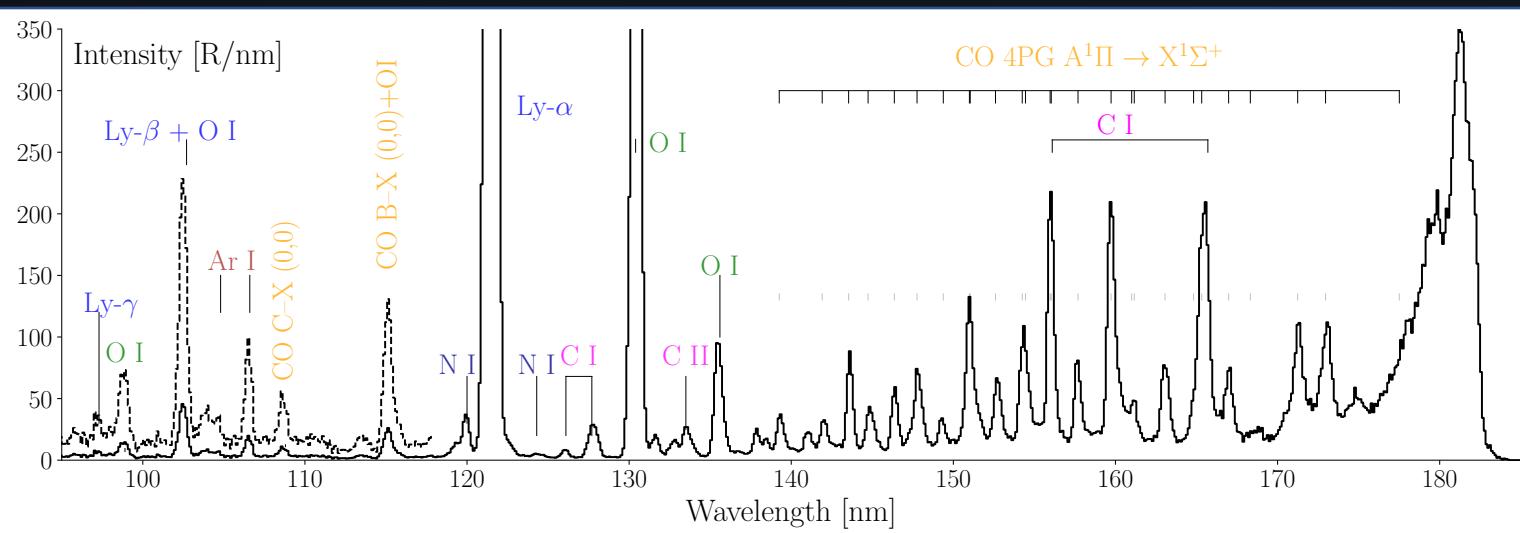


EMUS SCIENCE

- EMUS will provide a measure of the dynamics and energetics of the thermosphere.

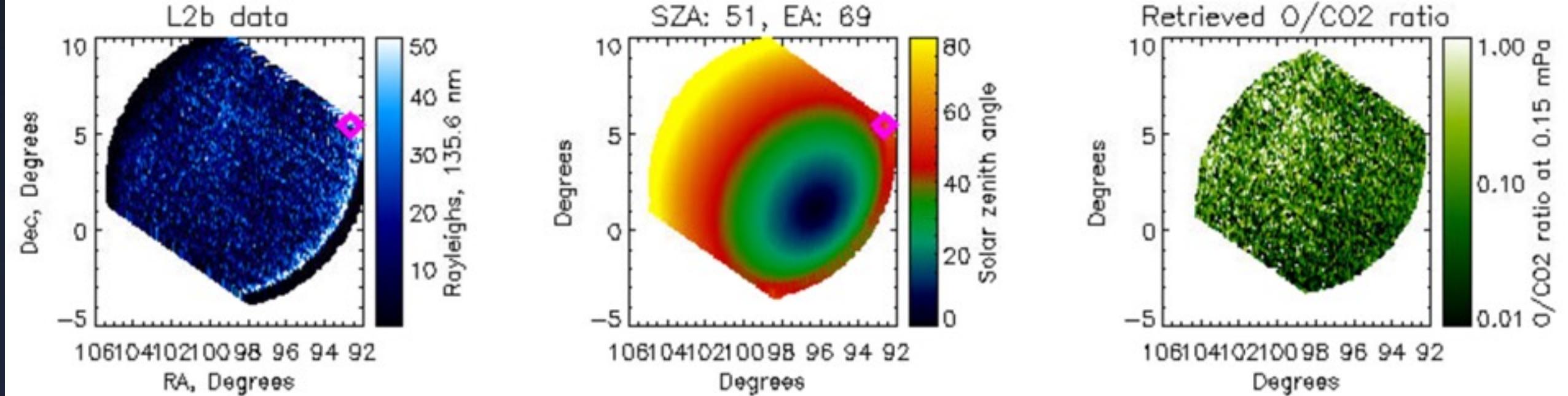
- The thermosphere forms the lower boundary of the exosphere, through which all escaping particles must travel.

- Key neutral species:
 - Oxygen
 - Carbon monoxide



EMUS SCIENCE

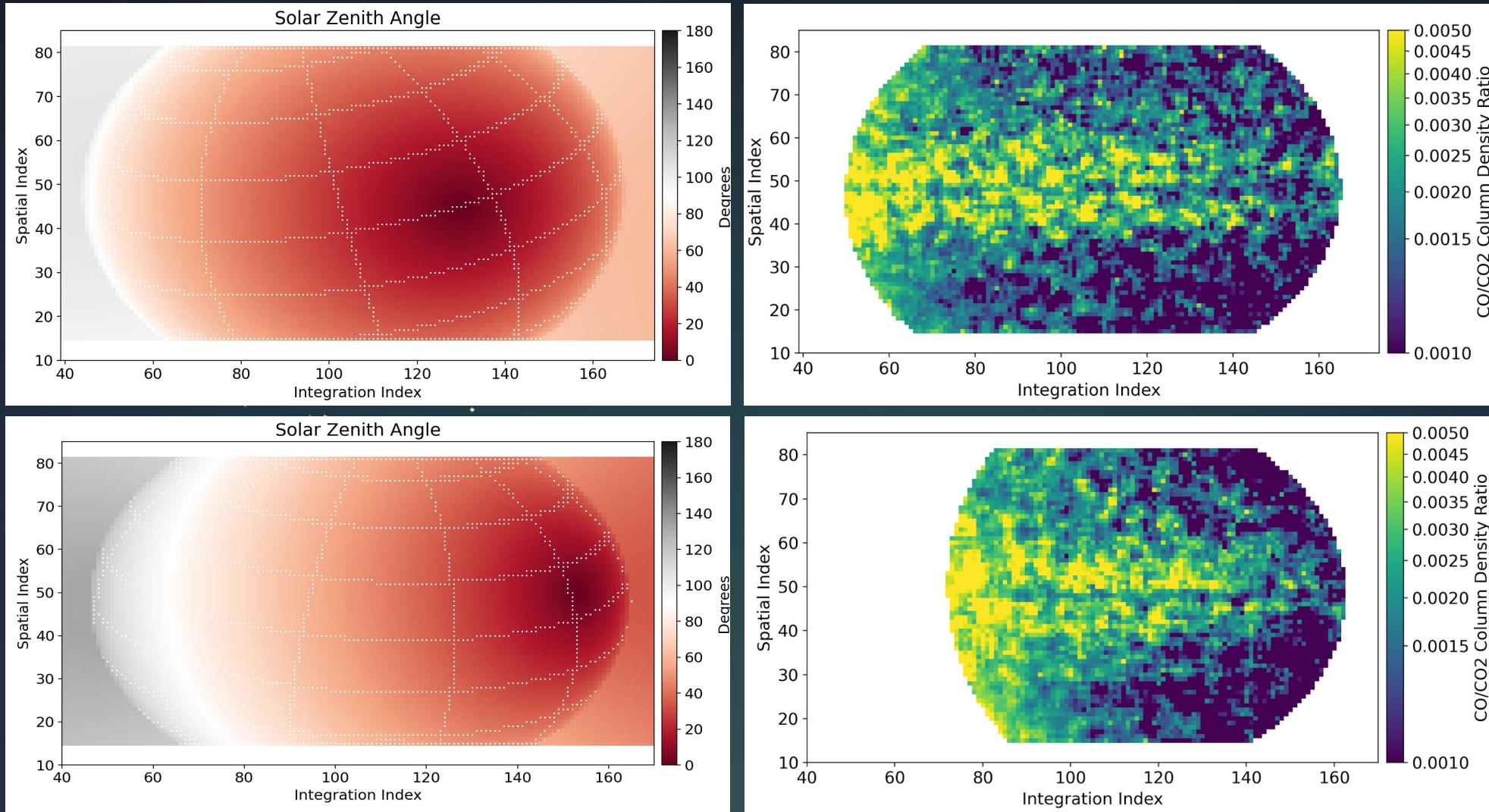
Oxygen in the thermosphere



April 24, 2021

EMUS SCIENCE

Carbon monoxide in the thermosphere

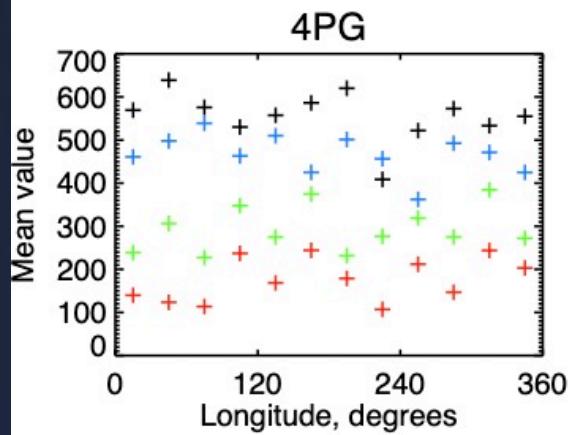
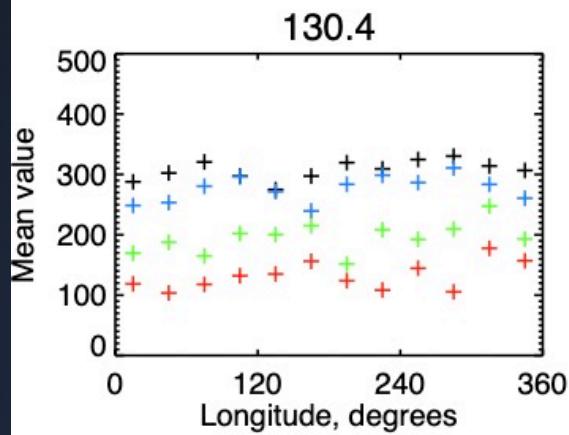


June 18, 2021

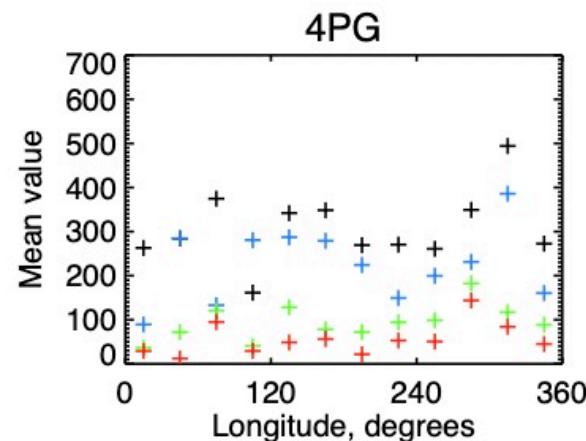
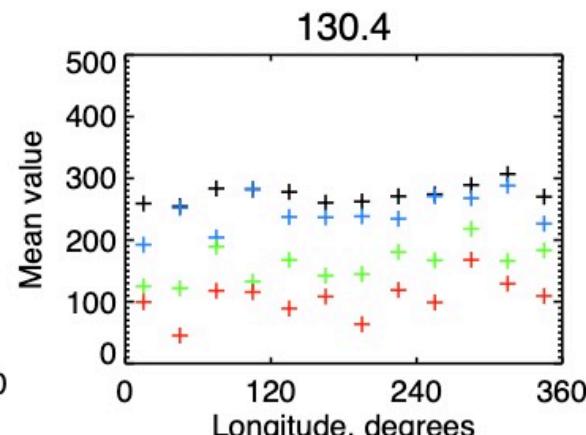
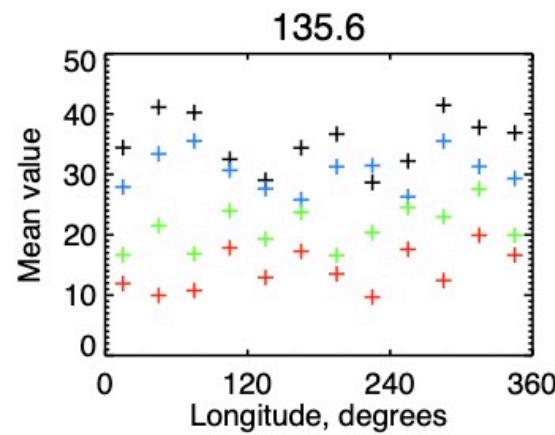
EMUS SCIENCE

Thermospheric waves

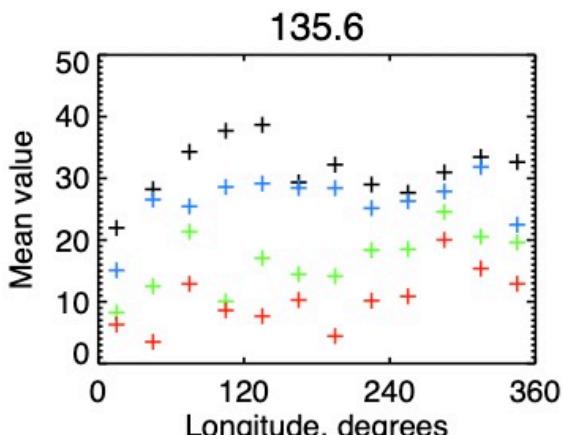
June 11 – July 31



August 1 – September 15



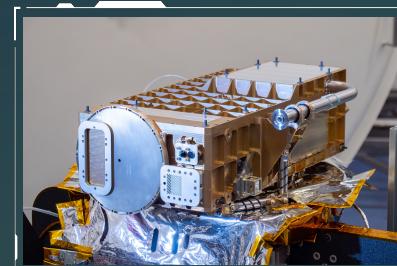
15-18 LT
14-17 LT
12-15 LT
10-13 LT



15-18 LT
14-17 LT
12-15 LT
10-13 LT

C

Characterize the spatial structure and
variability of key constituents in the Martian
exosphere.

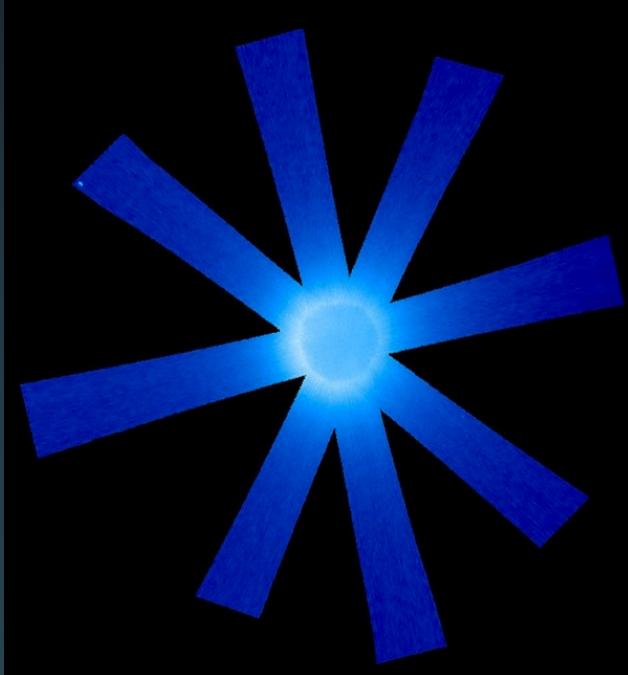
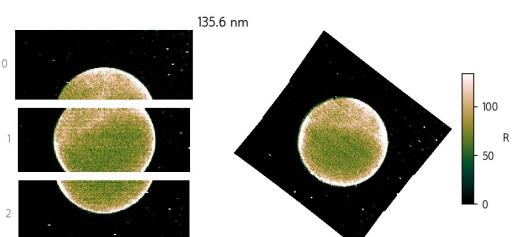
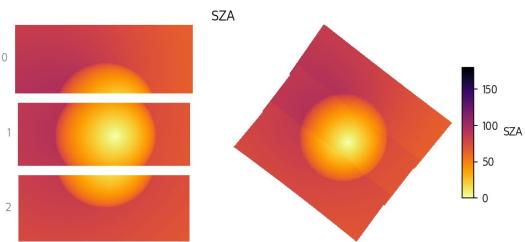
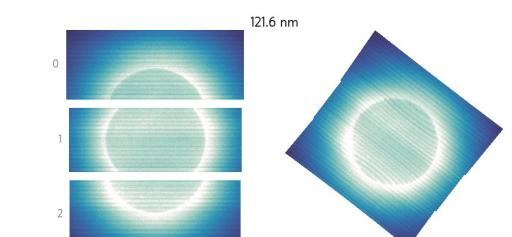
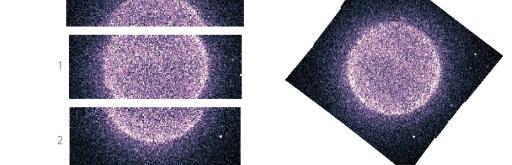
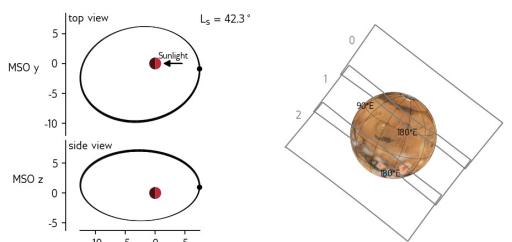


EMUS

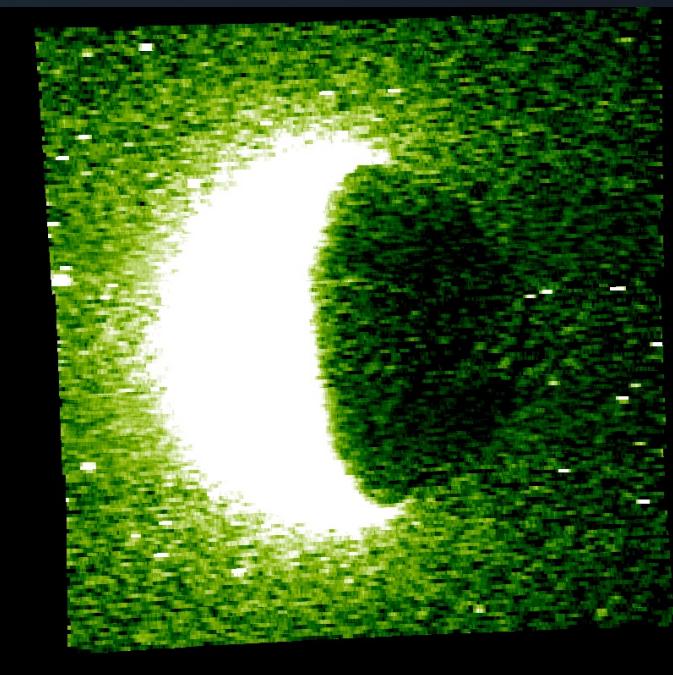
EMUS SCIENCE

Exosphere

OS 2 quicklook
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1: emm_emu_l2a_20210508t125604_0049_os2_sw2of3_r_v01-19.fits.gz
2: emm_emu_l2a_20210508t132040_0049_os2_sw3of3_r_v01-19.fits.gz



Atomic Hydrogen
121.6 nm

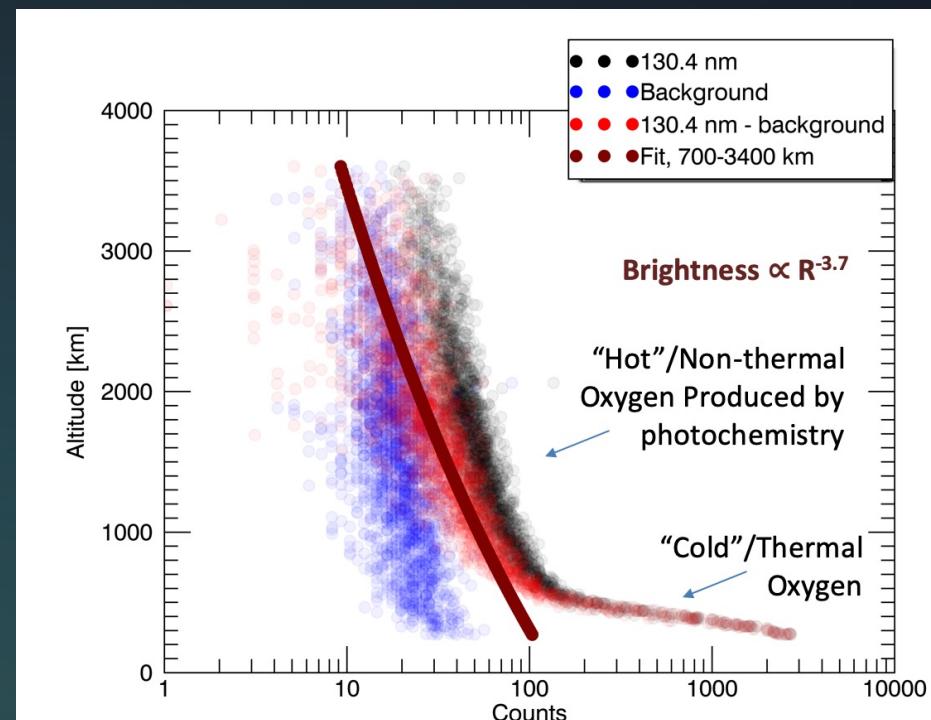
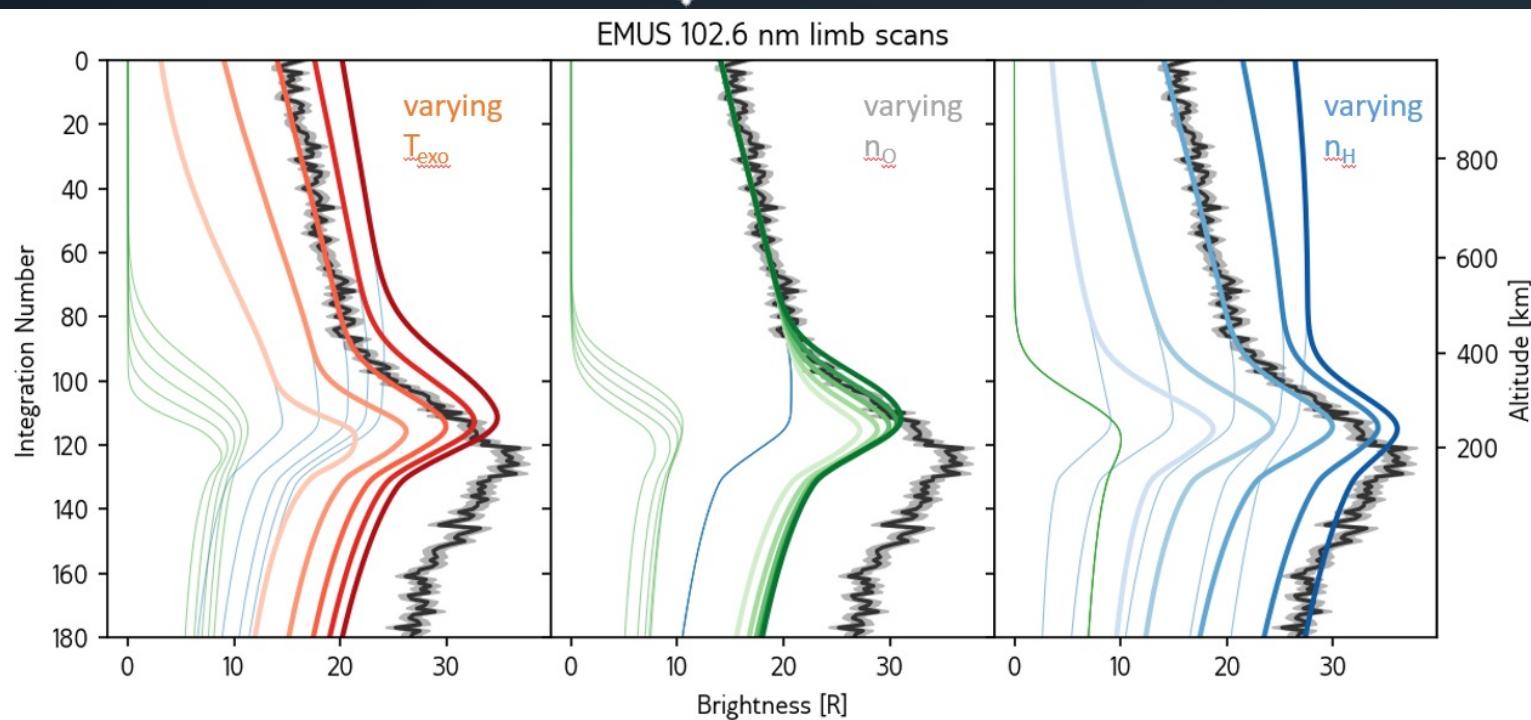


Atomic Oxygen
130.4 nm

H and O come from water (H_2O) broken up by sunlight
Observing H and O escape tells us about how Mars loses water

EMUS SCIENCE

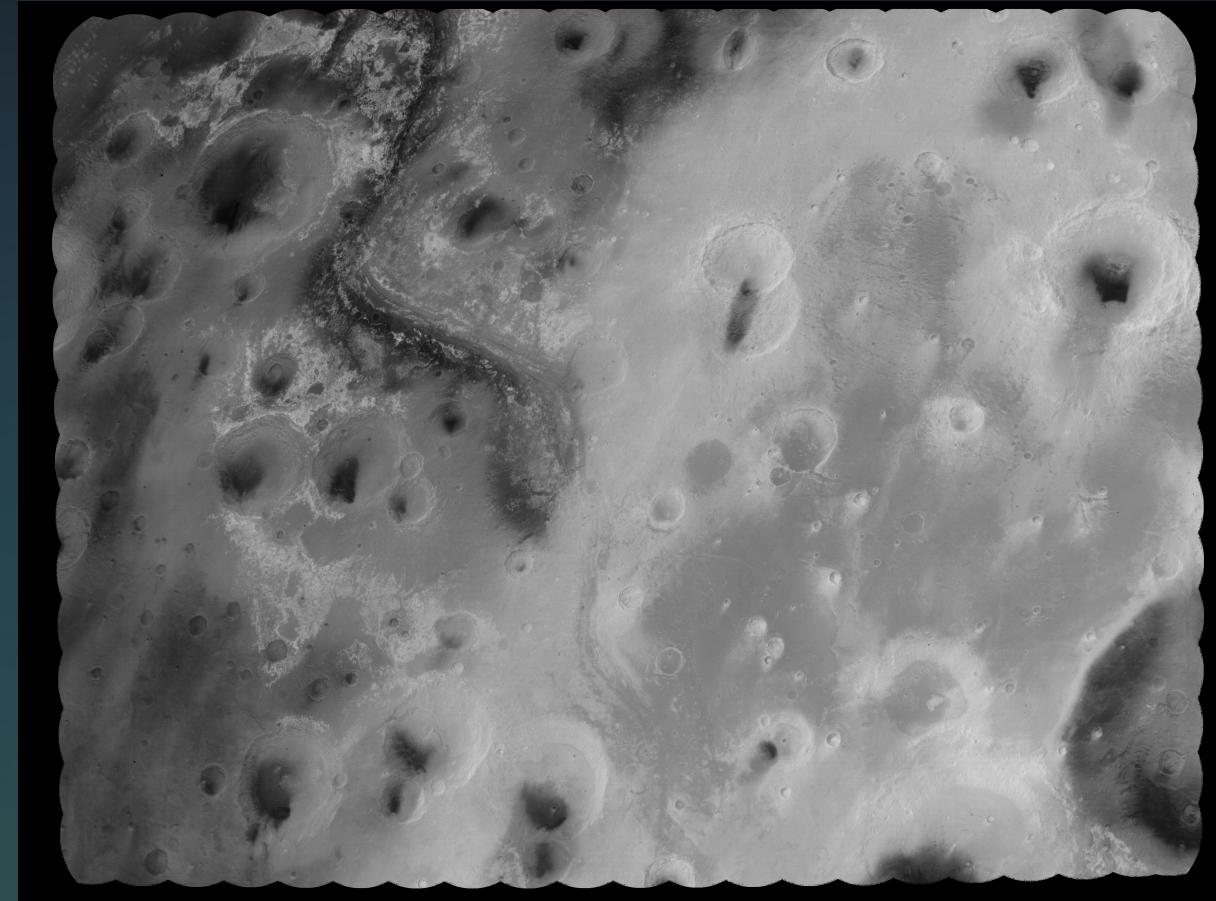
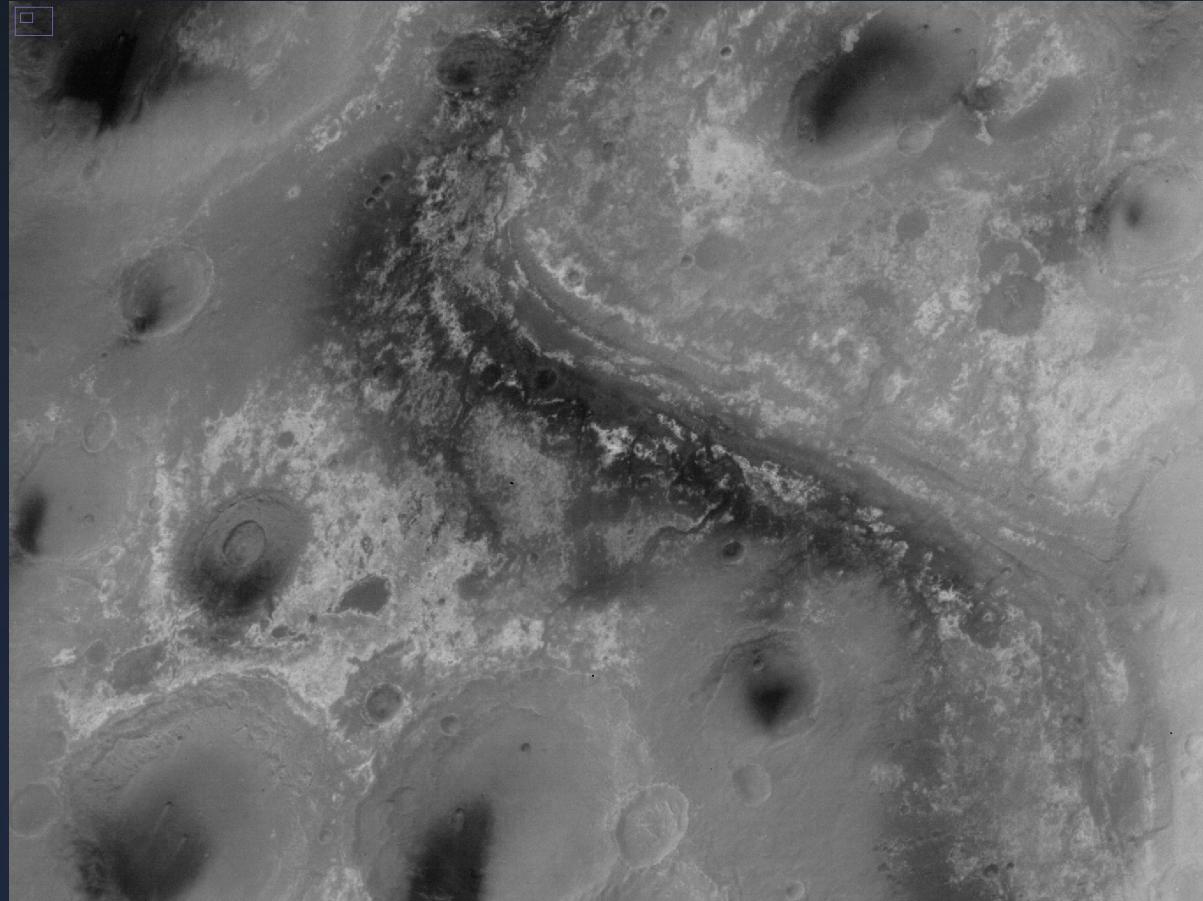
Hydrogen & Oxygen limb scans



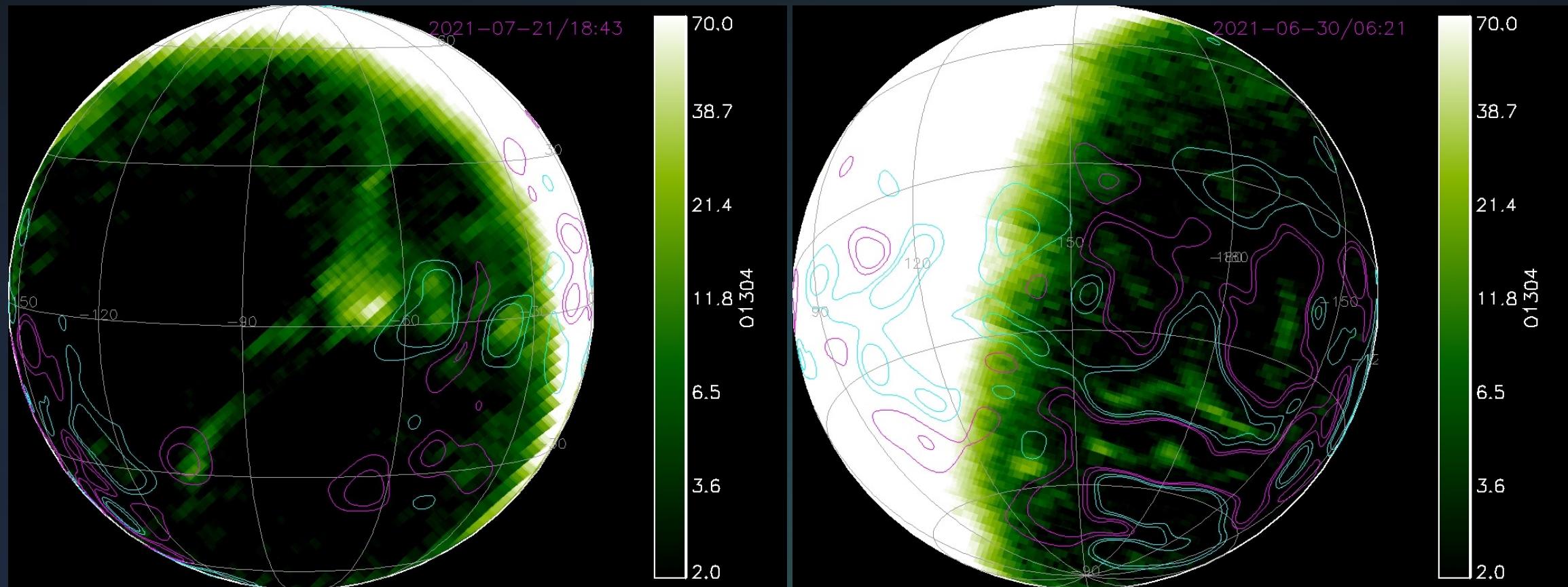


Opportunistic science

Surface Science



Discrete Aurora



Aurora are observed more than 50% of the time.



EMM Data Release

Data is accessible in emm.ae

The screenshot shows the EMM Science Data Center interface. At the top, there are tabs for HOME, DATA (which is selected), QUICKLOOK, SOFTWARE, PUBLICATIONS, and DOCUMENTATION. A search bar is located at the top right. Below the tabs, the title "EMM SCIENCE DATA CENTER" is displayed. On the left, there is a sidebar with sections for SCIENCE DATA, COLLAPSE ALL, CLEAR ALL, Date range (set to 2021-07-04 to 2021-07-21), Instrument (EMIRS, EMUS, EXI checked), Data level (L1A, L1B, L2, L2A, L2B, L3), and a SEARCH button. The main area displays a table of data files with columns for filename, instrument, data level, and date/time. The table includes rows for various EMIRS, EMUS, and EXI data products. At the bottom, there are buttons for FIND RELATED ANCILLARY DATA and DOWNLOAD SELECTED FILES.



sdc.emiratesmarsmission.ae

Feb – Aug 2021

Released Data

3 months

Frequency of Data
Release

L1⁺ Data

Available to Public

Free Access

Available to Everyone

Summary

- EMM is collecting successfully the science it's designed for building up a comprehensive vertical, global, and diurnal perspective of the atmosphere.
- EMM data is available in the emm.ae website. A new release is upcoming Apr 2022.
- We are currently planning a proposal for the extended mission.

